AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A machine-implemented method ~~of simulating a string, the method~~ comprising:

forming a first equation to model a movable end of a string of a musical instrument, the first equation relating an excursion in time of the movable end to ~~simulating~~ a force acting on the string, the force exerted by a simulated stream of a fluid medium flowing in a direction that has a component along a longitudinal axis of the string;

forming a wave equation that relates movement of the string in time to the excursion of the movable end~~force acting on the string~~; and

simulating the string to cause generation of ~~generating~~ a sound ~~based on~~by evaluating the ~~movement described in~~first equation and the wave equation.

2. (Original) A method according to claim 1, wherein:

the simulated string is supported between two supports and is aligned at rest in a first direction between the two supports;

a first of the two supports allows movement in a second direction orthogonal to the first direction and a second of the two supports does not allow movement; and

the string is caused from rest to vibrate in a plane, which includes the first and second directions, by turbulence in the fluid flow causing the stream of fluid medium to exert a pressure on the string in the second direction.

3. (Previously Presented) A method according to claim 2, wherein:

movement of the string out of alignment with the first direction causes the stream of fluid medium flowing in the first direction to exert the force on the string in the second direction.

4. (Original) A method according to claim 1, wherein:

the simulated string is supported between two supports aligned in a first direction,

a first of the two supports is rigid and a second of the two supports allows movement in a second direction orthogonal to the first direction; and

the string is caused to vibrate in a plane, which includes the first and second directions, by the stream of fluid medium flowing in a direction having a component in the second direction.

5. (Original) A method according to claim 1, wherein:

the simulated string is supported between two supports aligned in an x-direction;

a first of the two supports allows movement in a y-direction orthogonal to the x-direction and a second of the two supports does not allow movement;

the string comprises a plurality of discrete elements aligned at rest in the x-direction and spaced apart by a distance dx; and

the discrete elements are able to move in discrete steps of time dt in the y-direction only.

6. (Original) A method according to claim 5, in which the string comprises a plurality of j discrete elements from j=0 at one end movably supported by the first support to j=x-1 at the opposite end immovably supported by the second support; wherein

j is an integer; and

the stream of fluid medium flows in the x-direction and exerts a pressure on the string between elements j=0 and j=1.

7. (Currently Amended) A method according to claim 6, wherein the force $F_{PRES}[n, 0]$ at time n acting on the ~~immovably~~ movably supported element j=0 due to the pressure on the string between the movably supported element j=0 and adjacent element j=1 is given by:

$$F_{PRES}[n, 0] = P * (y[n, 0] - y[n, 1]) / dx$$

in which:

P denotes the pressure exerted by the stream of fluid medium on the string between the movably supported element j=0 and adjacent element j=0;

y[n, 0] denotes the excursion of the movably supported element j=0 at time n; and

y[n, 1] denotes the excursion of the adjacent element j=1 at time n.

8. (Currently Amended) A method according to claim 6, wherein the force $F_{TURB}[n, 0]$ at time n acting on the ~~immovably~~ movably supported element j=0 due to the turbulence in the stream of fluid medium is given by:

$$F_{TURB}[n, 0] = C_{TURB} * N_{RND}[n]$$

in which:

C_{TURB} denotes a turbulence coefficient; and

$N_{RND}[n]$ denotes a random signal.

9. (Original) A method according to claim 8, wherein the random signal comprises a low pass filtered noise.

10. (Original) A method according to claim 6, wherein the excursion y[n+1, 0] of the movably supported element for the next sample due to the pressure on the string between the movably supported element j=0 and adjacent element j=1 is given by:

$$y[n+1, 0] = y[n, 0] + (F_{PRES}[n, 0] + F_{TURB}[n, 0]) * dt^2 / M[0]$$

in which:

y[n, 0] denotes the excursion of the movably supported element j=0 at time n; and

$F_{PRES}[n, 0]$ denotes the force at time n acting on the movably supported element j=0 due to the pressure on the string between the movably supported element j=0 and adjacent element j=1;

$F_{TURB}[n, 0]$ denotes the force at time n acting on the movably supported element j=0 due to the turbulence in the stream of fluid medium; and

M[0] denotes the mass of the movably supported element j=0.

11. (Original) A method according to claim 10, wherein the excursion y[n+1, 0] is limited.

12. (Original) A method according to claim 6, wherein the stream of the fluid medium exerts a pressure on the string between each of the elements; and

wherein the force F[n, j] at time n acting on each discrete element from j=1 to j=x-2 due to the pressure P is given by:

F[n, j] = P[j] * (y[n, j] – y[n, j-1]) / dx + P[j] * (y[n, j] – y[n, j+1]) / dx.

13. (Previously Presented) A method according to claim 12, wherein the pressure P decreases linearly or exponentially with increasing j.

14. (Original) A method according to claim 5, wherein the wave equation is an approximation of the continuous wave equation

$$M\frac{\partial^2 y}{\partial t^2} = T\frac{\partial^2 y}{\partial x^2} - S\frac{\partial^4 y}{\partial x^4} + L_T\frac{\partial^3 y}{\partial x^2 \partial t} - L_S\frac{\partial^5 y}{\partial x^4 \partial t} - L_V\frac{\partial y}{\partial t} + F(x,t)$$

in which:

F(x, t) denotes an external force at coordinate x on the string at time t;

M denotes mass per length;

S denotes stiffness of the string;

T denotes tension of the string;

Ls denotes a loss associated with the stiffness of the string;

Lt denotes a loss associated with the tension of the string; and

Lv denotes a loss associated with the turbulent flow of the fluid medium.

15. (Original) A method according to claim 14, wherein the approximation of the continuous wave equation is the discrete recursion formula:

y[n+1, j] = (y[n, j-2]·c1 + y[n, j-1]·c2 + y[n, j]·c3 + y[n, j+1]·c2 + y[n, j+2]·c1 + y[n-1, j-2]·c4 + y[n-1, j-1]·c5 + y[n-1, j]·c6 + y[n1, j+1]·c5 + y[n-1, j+2]·c4) / M[j] + 2y[n, j] + F[n, j]/M[j]

in which:

$dx = 1$;

$dt = 1$;

y[n, j] denotes the excursion of discrete element j in the y-direction at time n;

y[n+1, j] denotes the excursion of discrete element j in the y-direction at time n+1;

y[n, j+1] denotes the excursion of discrete element j+1 in the y-direction at time n;

M[j] denotes the mass of discrete element j;

F[n, j] denotes an additional external force acting on a discrete element j at time n; and

c1 to c6 are coefficients, which depend on the material parameters of the string and the surrounding media.

16. (Previously Presented) A method according to claim 15, wherein

$c1 = -(S + Ls)$;

$c2 = T + 4S + Lt + 4Ls$;

$c3 = -(2T + 6S + Lv + 2Lt + 6Ls)$;

$c4 = Ls$;

$c5 = -(Lt + 4Ls)$; and

$c6 = Lv + 2Lt + 6Ls$.

17. (Previously Presented) A method according to claim 15, wherein the discrete recursion formula is solved for the elements adjacent the respective supports by providing a dummy element at opposite ends of the string so that the excursion y[n+1, -1] of a dummy element adjacent the movably supported element for the next sample is given by:

$$y[n+1, -1] = y[n+1, 0] - (y[n+1, 1] - y[n+1, 0])$$

and the excursion y[n+1, x] of a dummy element adjacent the immovably supported element for the next sample is given by:

$$y[n+1, x] = -y[n+1, x-2].$$

18. (Cancelled)

19. (Currently Amended) A machine readable medium providing executable computer program instructions which when executed cause a data processing system to perform a method ~~of simulating, in a machine, a string~~, the method comprising:

forming a first equation to model a movable end of a string of a musical instrument, the first equation relating an excursion in time of the movable end to ~~simulating~~ a force acting on the string, the force exerted by a simulated stream of a fluid medium flowing in a direction that has a component along a longitudinal axis of the string;

forming a wave equation that relates movement of the string in time to the excursion of the movable end~~the force acting on the string~~; and

simulating the string to cause generation of ~~generating~~ a sound ~~based on~~by evaluating the ~~movement described in~~first equation and the wave equation.

20. (Previously Presented) The machine readable medium according to claim 19, wherein:

the simulated string is supported between two supports and is aligned at rest in a first direction between the two supports;

a first of the two supports allows movement in a second direction orthogonal to the first direction and a second of the two supports does not allow movement; and

the string is caused from rest to vibrate in a plane, which includes the first and second directions, by turbulence in the fluid flow causing the stream of fluid medium to exert a pressure on the string in the second direction.

21. (Previously Presented) The machine readable medium according to claim 20, wherein:

movement of the string out of alignment with the first direction causes the stream of fluid medium flowing in the first direction to exert the force on the string in the second direction.

22. (Previously Presented) The machine readable medium according to claim 19, wherein:

the simulated string is supported between two supports aligned in a first direction,

a first of the two supports is rigid and a second of the two supports allows movement in a second direction orthogonal to the first direction; and

the string is caused to vibrate in a plane, which includes the first and second directions, by the stream of fluid medium flowing in a direction having a component in the second direction.

23. (Previously Presented) The machine readable medium according to claim 19, wherein:

the simulated string is supported between two supports aligned in an x-direction;

a first of the two supports allows movement in a y-direction orthogonal to the x-direction and a second of the two supports does not allow movement;

the string comprises a plurality of discrete elements aligned at rest in the x-direction and spaced apart by a distance dx; and

the discrete elements are able to move in discrete steps of time dt in the y-direction only.

24. (Previously Presented) The machine readable medium according to claim 23, in which the string comprises a plurality of j discrete elements from j=0 at one end movably supported by the first support to j=x-1 at the opposite end immovably supported by the second support; wherein

j is an integer; and

the stream of fluid medium flows in the x-direction and exerts a pressure on the string between elements j=0 and j=1.

25. (Currently Amended) The machine readable medium according to claim 24, wherein the force $F_{PRES}[n, 0]$ at time n acting on the ~~immovably~~ <u>movably</u> supported element j=0 due to the pressure on the string between the movably supported element j=0 and adjacent element j=1 is given by:

$$F_{PRES}[n, 0] = P * (y[n, 0] - y[n, 1]) / dx$$

in which:

P denotes the pressure exerted by the stream of fluid medium on the string between the movably supported element j=0 and adjacent element j=0;

y[n, 0] denotes the excursion of the movably supported element j=0 at time n; and

y[n, 1] denotes the excursion of the adjacent element j=1 at time n.

26. (Currently Amended) The machine readable medium according to claim 24, wherein the force $F_{TURB}[n, 0]$ at time n acting on the ~~immovably~~movably supported element j=0 due to the turbulence in the stream of fluid medium is given by:

$$F_{TURB}[n, 0] = C_{TURB} * N_{RND}[n]$$

in which:

C_{TURB} denotes a turbulence coefficient; and

$N_{RND}[n]$ denotes a random signal.

27. (Previously Presented) The machine readable medium according to claim 24, wherein the excursion y[n+1, 0] of the movably supported element for the next sample due to the pressure on the string between the movably supported element j=0 and adjacent element j=1 is given by:

$$y[n+1, 0] = y[n, 0] + (F_{PRES}[n, 0] + F_{TURB}[n, 0]) * dt^2 / M[0]$$

in which:

y[n, 0] denotes the excursion of the movably supported element j=0 at time n; and

$F_{PRES}[n, 0]$ denotes the force at time n acting on the movably supported element j=0 due to the pressure on the string between the movably supported element j=0 and adjacent element j=1;

$F_{TURB}[n, 0]$ denotes the force at time n acting on the movably supported element j=0 due to the turbulence in the stream of fluid medium; and

M[0] denotes the mass of the movably supported element j=0.

28. (Previously Presented) The machine readable medium according to claim 27, wherein the excursion y[n+1, 0] is limited.

29. (Previously Presented) The machine readable medium according to claim 24, wherein the stream of the fluid medium exerts a pressure on the string between each of the elements; and

wherein the force F[n, j] at time n acting on each discrete element from j=1 to j=x-2 due to the pressure P is given by:

F[n, j] = P[j] * (y[n, j] – y[n, j-1]) / dx + P[j] * (y[n, j] – y[n, j+1]) / dx.

30. (Previously Presented) The machine readable medium according to claim 29, wherein the pressure P decreases linearly or exponentially with increasing j.

31. (Previously Presented) The machine readable medium according to claim 23, wherein the wave equation is an approximation of the continuous wave equation

$$M\frac{\partial^2 y}{\partial t^2} = T\frac{\partial^2 y}{\partial x^2} - S\frac{\partial^4 y}{\partial x^4} + L_T\frac{\partial^3 y}{\partial x^2 \partial t} - L_S\frac{\partial^5 y}{\partial x^4 \partial t} - L_V\frac{\partial y}{\partial t} + F(x,t)$$

in which:

F(x, t) denotes an external force at coordinate x on the string at time t;

M denotes mass per length;

S denotes stiffness of the string;

T denotes tension of the string;

Ls denotes a loss associated with the stiffness of the string;

Lt denotes a loss associated with the tension of the string; and

Lv denotes a loss associated with the turbulent flow of the fluid medium.

32. (Previously Presented) The machine readable medium according to claim 31, wherein the approximation of the continuous wave equation is the discrete recursion formula:

y[n+1, j] = (y[n, j-2]·c1 + y[n, j-1]·c2 + y[n, j]·c3 + y[n, j+1]·c2 + y[n, j+2]·c1 + y[n-1, j-2]·c4 + y[n-1, j-1]·c5 + y[n-1, j]·c6 + y[n1, j+1]·c5 + y[n-1, j+2]·c4) / M[j] + 2y[n, j] + F[n, j]/M[j]

in which:

dx = 1;

dt = 1;

y[n, j] denotes the excursion of discrete element j in the y-direction at time n;

y[n+1, j] denotes the excursion of discrete element j in the y-direction at time n+1;

y[n, j+1] denotes the excursion of discrete element j+1 in the y-direction at time n;

M[j] denotes the mass of discrete element j;

F[n, j] denotes an additional external force acting on a discrete element j at time n; and

c1 to c6 are coefficients, which depend on the material parameters of the string and the surrounding media.

33. (Previously Presented) The machine readable medium according to claim 32, wherein

c1 = -(S + Ls);

c2 = T + 4S + Lt +4Ls;

c3 = -(2T +6S + Lv + 2Lt + 6Ls);

c4 = Ls;

c5 = -(Lt + 4Ls); and

c6 = Lv +2Lt +6Ls.

34. (Previously Presented) The machine readable medium according to claim 32, wherein the discrete recursion formula is solved for the elements adjacent the respective supports by providing a dummy element at opposite ends of the string so that the excursion y[n+1, -1] of a dummy element adjacent the movably supported element for the next sample is given by:

y[n+1, -1] = y[n+1, 0] - (y[n+1, 1] - y[n+1, 0])

and the excursion y[n+1, x] of a dummy element adjacent the immovably supported element for the next sample is given by:

y[n+1, x] = -y[n+1, x-2].

35. (Cancelled)

36. (Currently Amended) An apparatus ~~for simulating, in a machine, a string, the apparatus~~ comprising:

a processing element to evaluate a first equation that models a movable end of a string of a musical instrument, the first equation to relate an excursion in time of the movable end to ~~simulate~~ a force acting on the string ~~by a stream of a fluid medium flowing in a direction that has a component along a longitudinal axis of the string~~ and to evaluate ~~form~~ a wave equation that relates movement of the string in time to the excursion of the movable end, wherein the force is exerted by a simulated stream of a fluid medium flowing in a direction that has a component along a longitudinal axis of the string ~~force acting on the string~~;

a sound generating element, coupled to the processing element, to generate a sound based on the ~~movement described in~~first equation and the wave equation evaluated by the processing element; and

a storage device, coupled to the processing element, to store data used in evaluation of the first equation and the wave equation for simulating the string.

37. (Original) An apparatus according to claim 36, wherein:

the simulated string is supported between two supports and is aligned at rest in a first direction between the two supports;

a first of the two supports allows movement in a second direction orthogonal to the first direction and a second of the two supports does not allow movement; and

the string is caused from rest to vibrate in a plane, which includes the first and second directions, by turbulence in the fluid flow causing the stream of fluid medium to exert a pressure on the string in the second direction.

38. (Previously Presented An apparatus according to claim 37, wherein:

movement of the string out of alignment with the first direction causes the stream of fluid medium flowing in the first direction to exert the force on the string in the second direction.

39. (Original) An apparatus according to claim 36, wherein:

the simulated string is supported between two supports aligned in a first direction,

a first of the two supports is rigid and a second of the two supports allows movement in a second direction orthogonal to the first direction; and

the string is caused to vibrate in a plane, which includes the first and second directions, by the stream of fluid medium flowing in a direction having a component in the second direction.

40. (Original) An apparatus according to claim 36, wherein:

the simulated string is supported between two supports aligned in an x-direction;

a first of the two supports allows movement in a y-direction orthogonal to the x-direction and a second of the two supports does not allow movement;

the string comprises a plurality of discrete elements aligned at rest in the x-direction and spaced apart by a distance dx; and

the discrete elements are able to move in discrete steps of time dt in the y-direction only.

41. (Original) An apparatus according to claim 40, in which the string comprises a plurality of j discrete elements from j=0 at one end movably supported by the first support to j=x-1 at the opposite end immovably supported by the second support; wherein

j is an integer; and

the stream of fluid medium flows in the x-direction and exerts a pressure on the string between elements j=0 and j=1.

42. (Currently Amended) An apparatus according to claim 41, wherein the force $F_{PRES}[n, 0]$ at time n acting on the ~~immovably~~movably supported element j=0 due to the pressure on the string between the movably supported element j=0 and adjacent element j=1 is given by:

$$F_{PRES}[n, 0] = P * (y[n, 0] - y[n, 1]) / dx$$

in which:

P denotes the pressure exerted by the stream of fluid medium on the string between the movably supported element j=0 and adjacent element j=0;

y[n, 0] denotes the excursion of the movably supported element j=0 at time n; and

y[n, 1] denotes the excursion of the adjacent element j=1 at time n.

43. (Currently Amended) An apparatus according to claim 41, wherein the force $F_{TURB}[n, 0]$ at time n acting on the ~~immovably~~movably supported element j=0 due to the turbulence in the stream of fluid medium is given by:

$$F_{TURB}[n, 0] = C_{TURB} * N_{RND}[n]$$

in which:

C_{TURB} denotes a turbulence coefficient; and

$N_{RND}[n]$ denotes a random signal.

44. (Cancelled).

45. (Original) An apparatus according to claim 41, wherein the excursion y[n+1, 0] of the movably supported element for the next sample due to the pressure on the string between the movably supported element j=0 and adjacent element j=1 is given by:

$$y[n+1, 0] = y[n, 0] + (F_{PRES}[n, 0] + F_{TURB}[n, 0])*dt^2 / M[0]$$

in which:

y[n, 0] denotes the excursion of the movably supported element j=0 at time n; and

$F_{PRES}[n, 0]$ denotes the force at time n acting on the movably supported element j=0 due to the pressure on the string between the movably supported element j=0 and adjacent element j=1;

$F_{TURB}[n, 0]$ denotes the force at time n acting on the movably supported element j=0 due to the turbulence in the stream of fluid medium; and

M[0] denotes the mass of the movably supported element j=0.